



RECEIVED
JUN 13 2003
TC 1700

Serial No. 09/855,972
Gillis Affidavit

**PATENT
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In Re Application of:

Martin et al.

Serial No.: 09/855,972

Filed: 05/15/2001

Group Art Unit: 1763

Examiner: Parviz Hassanzadeh

Docket No. 062002-1751

For: **Method And Apparatus For Low Energy Electron Enhanced Etching Of Substrates In An AC Or DC Plasma Environment**

DECLARATION OF HARRY P. GILLIS UNDER 37 C.F.R. 1.132

I, Harry P. Gillis, residing at 1540 Armacost Avenue, #2 Los Angeles, CA, being of over 21 years of age, and being of sound mind and disposition, make the following statement:

1. I am the joint inventor of U.S. Patent Application Serial No. 08/932,025.
2. I graduated from Louisiana State University in 1968 with a bachelor's degree in Chemistry and Physics.
3. In 1973, I graduated from The University of Chicago with a Doctor of Philosophy degree in Chemical Physics.
4. I have five (5) United States patents in the field of low energy electron enhanced etching: U.S. Pat. No. 5, 882,528; U.S. Pat. No. 5,917,285; U.S. Pat. No. 6, 027, 663; U.S. Pat. No. 6,033,587; and U.S. Pat. No. 6,258,287.
5. In refereed journals, I have six (6) publications in the field of low energy electron enhanced etching. The publications were included in the IDS mailed to the U.S.P.T.O on October 25, 2001, and are entitled: "Low-Energy Electron Beam Enhanced Etching of Si(100)-(2x1) by Molecular Hydrogen"; "Low Energy Electron-Enhanced Etching of Si(100) in Hydrogen/Helium Direct-Current Plasma"; "The Dry Etching of Group III-Nitride Wide-Bandgap

Serial No. 09/855,972
Gillis Affidavit

Semiconductors"; "Low Energy Electron-Enhanced Etching of GaAs(100) In a Chlorine/Hydrogen DC Plasma"; "Low Energy Electron-Enhanced Etching of GaN/Si in Hydrogen Direct Current Plasma"; and "Highly Anisotropic, Ultra-Smooth Patterning of GaN/SiC by Low Energy Electron Enhanced Etching in DC Plasma".

6. I am currently employed by University of California, Los Angeles (UCLA) and have been continuously employed by UCLA since 1994.
7. My duties with UCLA include teaching undergraduate and graduate courses and conducting research in surface science including the field of low energy enhanced electron etching.
8. Through my work experience, I became particularly involved with the reduction and elimination of damage to surfaces caused by dry etching.
9. In my experience, I became familiar with the use of low energy enhanced electron etching.
10. I have reviewed the cited art of record: *Gorin*, U.S. Pat. No. 4,464,223; *Kaji et al.*, U.S. Pat. No. 5,290,993; *Tamura et al.*, U.S. Pat. No. 5,06,684; and *Okano*, JP 56-081678.
11. The cited references are directed to Ion Enhanced Etching Plasma Reactors in which a substrate is etched by positive ions. The substrate in an Ion Enhanced Etching Plasma Reactor is biased by a continuous wave power supply.
12. In Ion Enhanced Etching Plasma Reactors, a continuous wave power source is used to bias the surface of a substrate. Due to the difference in mass between electrons and ions, the mobility of electrons is greater than the mobility of ions. For reasons of efficiency, the continuous wave power source operates at high frequencies, typically at 13.56 MHz. Initially, during the negative half-cycle of the power source, ions in the plasma do not impinge upon the substrate because the ions are too heavy and slow to arrive at the substrate during the negative half-cycle of the power supply. During the positive half-cycle of the power source, electrons are attracted to the substrate and some electrons adhere to the substrate.

Serial No. 09/855,972
Gillis Affidavit

Consequently, after several full cycles of the power source, excess electron charge builds up on the substrate, thereby producing a time average negative DC potential on the substrate. In response to the time average negative DC potential, positive ions are attracted to the substrate and etch material therefrom.

13. The cited references fail to disclose a pulsed power supply in an Ion Enhanced Etching Plasma Reactor.
14. In an Electron Enhanced Etching Plasma Reactor, a pulsed power supply that is used to bias the etching substrate cycles between a positive voltage and a negative voltage. During the positive voltage portion of a cycle, electrons etch the substrate and some of the electrons accumulate thereon. During the negative voltage portion of a cycle, positive ions are attracted to the substrate and substantially neutralize the accumulated electrons.
15. A continuous wave power supply will not work to bias the sample in an Electron Enhanced Etching Plasma Reactor because a continuous wave power supply cannot generate a time average positive DC offset necessary to pull electrons from the plasma to etch the surface of a substrate. The fundamental difference in mobilities between ions and electrons in a plasma enables creation of a time average negative DC offset at the sample by a continuous power supply and prevents creation of a positive DC offset by a continuous power supply.

DECLARATION

I hereby declare under penalty of perjury under the laws of the United States of America that all statements made herein of my own knowledge are true and correct and that all statements made on information and belief are believed to be true and correct; and further that these statements were made with the knowledge that willful false statement and the like so made are punishable by fine or

Serial No. 09/855,972
Gillis Affidavit

imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

5 June 2003
Date

Harry P. Gillis
Harry P. Gillis